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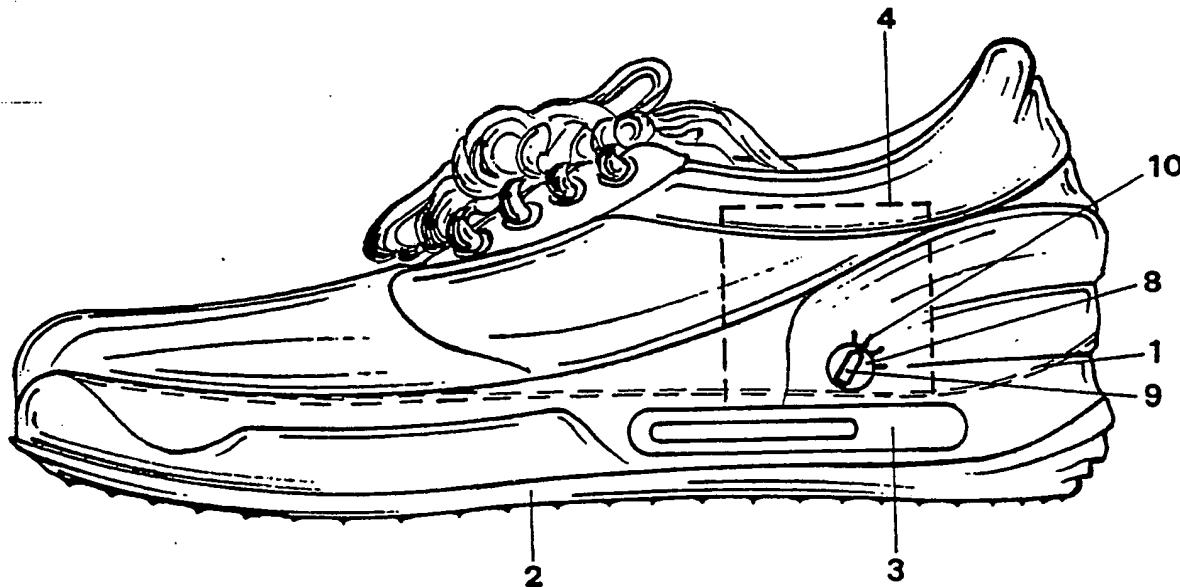


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(54) Title: FOOTWEAR WITH SOLE PROVIDED WITH A CUSHIONING DEVICE



(57) Abstract

Footwear with its sole provided with a cushioning device, characterized in that said cushioning device comprises a first reservoir (3) with deformable but inextensible walls, interposed between the plantar (1) and tread (2) and containing a substantially incompressible fluid, and a second reservoir (4) communicating with the first through a first passage (5) of adjustable cross-section and a second unidirectional passage (6) from the second reservoir (4) to the first reservoir (3).

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## FOOTWEAR WITH SOLE PROVIDED WITH A CUSHIONING DEVICE

This invention relates to footwear with its sole provided with a cushioning device.

Sports footwear is known in which the sole is provided with a pneumatic cushioning device interposed between the 5 plantar and the tread. This cushioning device consists substantially of an air cushion which because of its compressibility attenuates the impact of the foot during walking or running.

This known footwear offers considerable comfort to a 10 sportsman but at the same time is limited in its use because it cannot be adapted to the individual person either to take account of physical characteristics or to take account of the particular manner in which it is used.

Sports footwear is also known provided with a cushioning 15 device consisting of a gel cushion which operates not on the principle of air compressibility but on the principle of displacement of the incompressible gel mass. Different cushioning effects can be obtained depending on the gel viscosity, but the effect is fixed for each type of footwear 20 and is unable to vary as conditions vary during use.

A further drawback of known sports footwear provided with a cushioning device is that the cushioning effect is not only fixed but can be influenced by external environmental

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factors such as temperature, altitude, pressure etc. without any correction being possible.

An object of the invention is to provide footwear with its sole provided with a cushioning device having 5 characteristics adaptable to the individual person.

A further object of invention is to provide footwear in which the cushioning effect can be adjusted in an extremely rapid and simple manner.

These and further objects which will be apparent from 10 the description given hereinafter are attained according to the invention by footwear with its sole provided with a cushioning device, characterised in that said cushioning device comprises a first reservoir with deformable but inextensible walls, interposed between the plantar and tread 15 and containing a substantially incompressible hydraulic fluid, and a second reservoir communicating with the first through a first passage of adjustable cross-section and a second unidirectional passage from the second reservoir to the first reservoir.

20 Two preferred embodiments and some modifications of the present invention are described in detail hereinafter with reference to the accompanying drawing in which:

Figure 1 is a diagrammatic side view of a first embodiment of

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an article of sports footwear with its sole provided with the cushioning device according to the invention;

Figure 2 is a schematic view of its hydraulic adjustment  
5 circuit;

Figure 3 is a partial representation of a different embodiment thereof in the same view as Figure 1;

Figure 4 is a modification shown in the same view as Figure  
3; and

10 Figure 5 is a further modification shown schematically in the same view as Figure 3.

AS can be seen from the figures the sports footwear according to the invention comprises, interposed between the plantar 1 and tread 2, a cushion 3 consisting of a flat reservoir with deformable but inextensible walls filled with an incompressible fluid, preferably oil. A further reservoir 4 with elastically deformable walls is provided inside the article of footwear not below the plantar 1, but in a region not exposed to the impact of the foot. It can for example be provided in the side portion of the vamp or in the heel region and communicate with the first reservoir 3 through two conduits 5 and 6.  
20

A flow regulator valve 7 is connected into the conduit 5

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and is adjustable from the outside for example by means of a screw 8 provided with a pointer mobile along a graduated scale 10. There is connected into the conduit 6 a non-return valve 11, ie a valve which exerts practically no resistance 5 to oil transfer from the reservoir 4 to the reservoir 3, but prevents its transfer in the opposite direction.

In an embodiment not shown on the drawings it is also possible for the two conduits 5 and 6 to consist in fact of a single conduit provided with a non-return valve in which a 10 constriction adjustable from the outside is provided.

The operation of the footwear according to the invention is as follows:

during use, each time the sportsman's foot presses on the plantar 1 it compresses the cushion 3 which, because of the 15 deformability of its inextensible walls and the incompressibility of the oil contained within it, causes the oil to be forcibly transferred from the reservoir 4 and through the flow regulator valve 7, which in this stage is the only passage allowed. This transfer takes place at a 20 greater or lesser rate depending on the adjustment of said valve 7, to correspond to a greater or lesser accentuated cushioning effect in response to the impact of the sportsman's foot.

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AS the oil is transferred into the reservoir 4, the walls of this latter yield laterally so that when the pressing action on the plantar 1 ceases, ie when the foot no longer rests on the plantar 1, the oil returns to the 5 reservoir 3 through the conduit 6 and non-return valve 11, which now opens. The stated cushioning effect is obviously also a function of the degree of elastic yieldability of the walls of the reservoir 4.

In practice, the assembly consisting of the reservoir 3, 10 the reservoir 4, the two conduits 5 and 6 and the valves 7 and 11 form a sort of hydraulic damper which effectively attenuates the impact of the sportsman's foot on the plantar while at the same time allowing its effect to be adjusted to adapt it to the sportsman's requirements and the conditions 15 under which it is used.

The embodiment shown in Figure 3 differs from the embodiment shown in Figure 1 in that the compensation reservoir 4 is fitted external to the vamp and is visible from the outside. This embodiment, which is operationally 20 identical to the preceding, may be preferred in those cases in which it is required to give the footwear a "technical" appearance.

Elastic means are inserted into the reservoir 4 to

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cooperate with the reservoir walls and thus obtain a more rapid and effective elastic return of the oil from the reservoir 4 to the reservoir 3 when the pressure on this latter ceases, and for adjusting this elasticity. These 5 elastic means can consist for example of a spring 12 housed in the reservoir 4 and arranged to elastically oppose the expansion of its wall, which is preferably of bellows shape (see Figure 4). A screw device 13 is provided for adjusting the preloading of said spring 12.

10 In the modification shown in Figure 5 the reservoir 4 consists in reality of a cylinder 14 containing in its interior a piston 15 which divides it into two chambers 16, 17, one of which, 16, communicates with the conduits 5 and 6 and houses the oil originating from the reservoir 3, while 15 the other 17, which is completely closed, is filled with compressible fluid such as air.

In this case the elastic means which oppose the filling of the reservoir 4 are represented by the compressed air contained in the chamber 17. The air pressure in the chamber 20 17 is adjustable to allow adjustment of the elastic reaction to the entry of oil into the reservoir 4. This can be done by varying the volume of said chamber, and specifically by displacing its head 18 by an adjustment screw 19, or by

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varying the quantity of air fed into the chamber by means of a valve (not shown).

From the foregoing it is apparent that the footwear according to the invention is extremely advantageous in that 5 not only does it attenuate the impact of the foot during walking or running as in the case of known footwear provided with a cushioning device, but in contrast to this latter it allows the cushioning effect to be adapted to the individual person in an extremely rapid and simple manner on the basis 10 of the specific characteristics and conditions of use.

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#### C L A I M S

1. Footwear with its sole provided with a cushioning device, characterised in that said cushioning device comprises a first reservoir (3) with deformable but 5 inextensible walls, interposed between the plantar (1) and tread (2) and containing a substantially incompressible fluid, and a second reservoir (4) communicating with the first through a first passage (5) of adjustable cross-section and a second unidirectional passage (6) from the second 10 reservoir (4) to the first reservoir (3).
2. Footwear as claimed in claim 1, characterised in that the second reservoir (4) is housed within the sole in a region not exposed to the impact of the foot.
3. Footwear as claimed in claim 1, characterised in that 15 the second reservoir (4) is housed within the vamp.
4. Footwear as claimed in claim 1, characterised in that the second reservoir (4) is housed external to the vamp.
5. Footwear as claimed in claim 1, characterised by comprising in the first passage a regulator valve (7) 20 operable from the outside.
6. Footwear as claimed in claim 5, characterised in that the valve (7) is provided with an adjustment screw (8) positioned in proximity to the sole.

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7. Footwear as claimed in claim 5, characterised in that the valve (7) is provided with an adjustment screw having a pointer (9) mobile along a graduated scale (10).

5 8. Footwear as claimed in claim 1, characterised in that the two passages ((5, 6) are formed in a single conduit provided with a non-return valve (11) associated with the flow regulator device (7).

9. Footwear as claimed in claim 1, characterised in that elastic means are provided within the reservoir (4) to oppose 10 the entry of oil into the reservoir.

10. Footwear as claimed in claim 9, characterised in that the second reservoir (4) is formed with bellows-shaped walls.

11. Footwear as claimed in claim 10, characterised by comprising a spring (12) within said second reservoir (4).

15 12. Footwear as claimed in claim 11, characterised in that the spring (12) is provided with a screw device (13) for adjusting its preload.

13. Footwear as claimed in claim 10, characterised in that the second reservoir (4) consists of a cylinder (14) the 20 piston (15) of which divides it into a closed chamber (17) containing a compressible fluid and into another chamber (16) communicating with the first reservoir (3).

14. Footwear as claimed in claim 13, characterised in that

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the closed chamber (17) is associated with a screw device (19) for adjusting its volume.

15. Footwear as claimed in claim 13, characterised in that  
the closed chamber (17) is provided with a feed valve for  
5 compressible fluid.

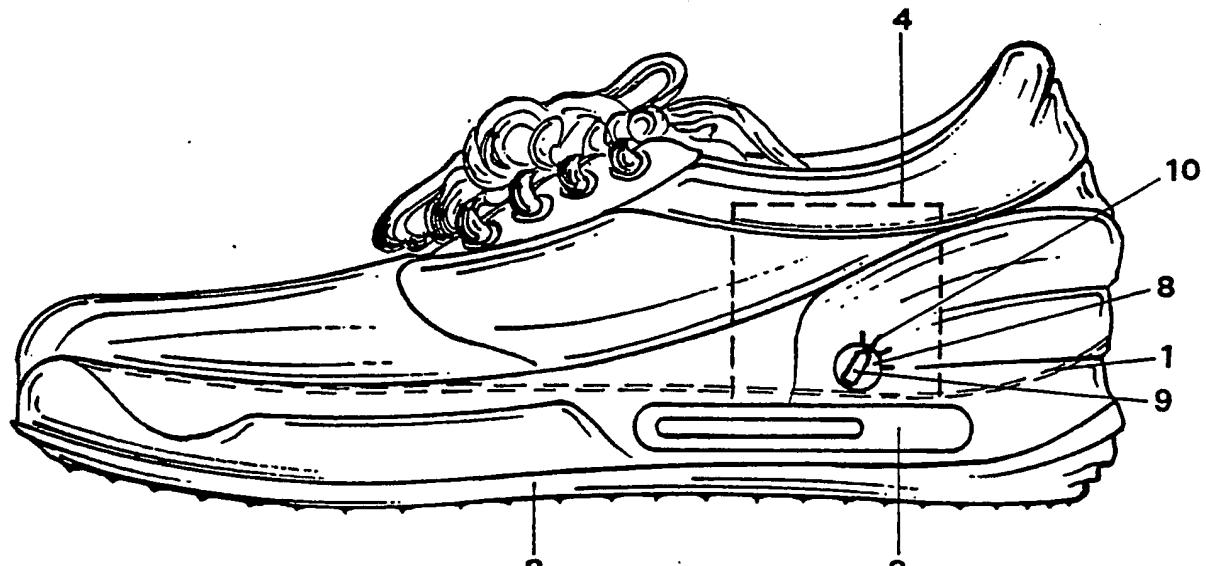


FIG.1

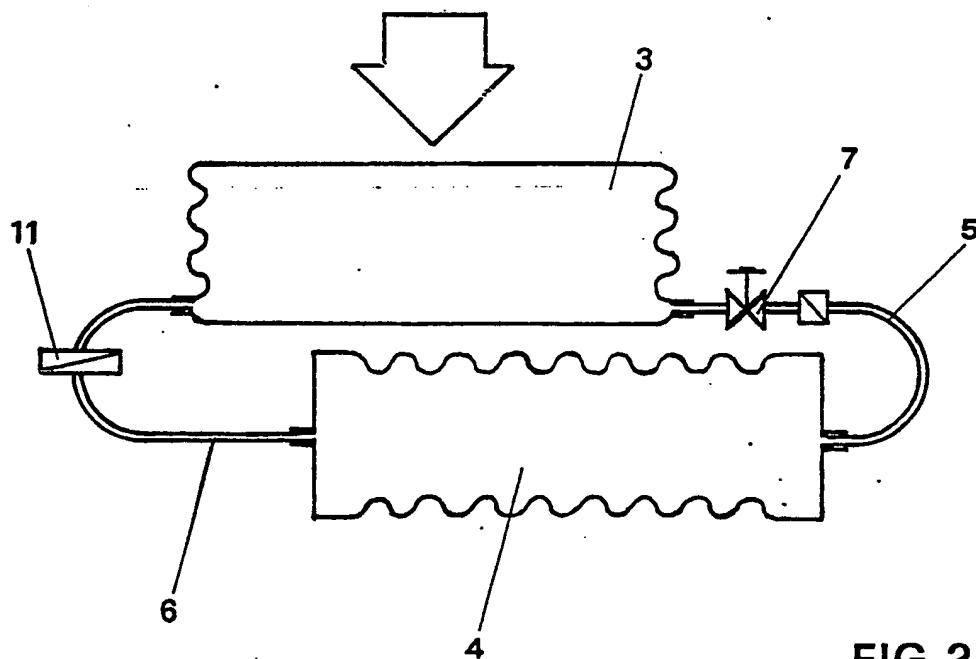


FIG.2

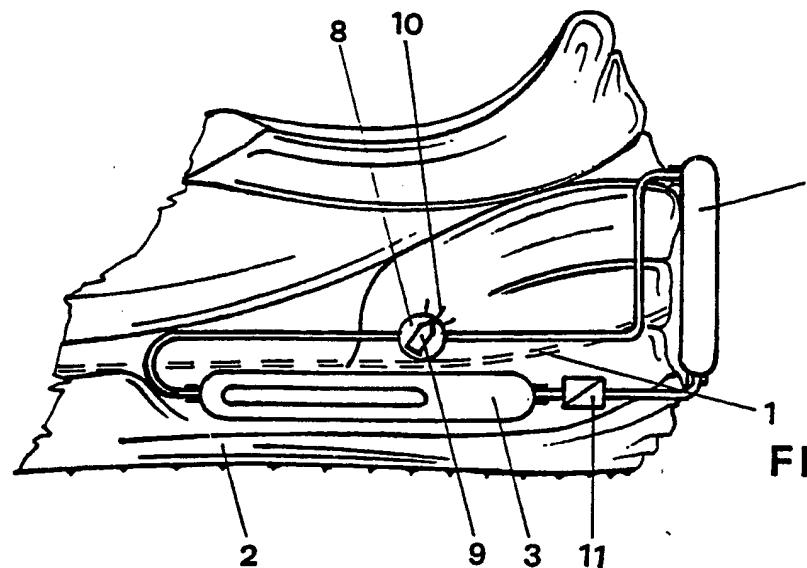


FIG.3

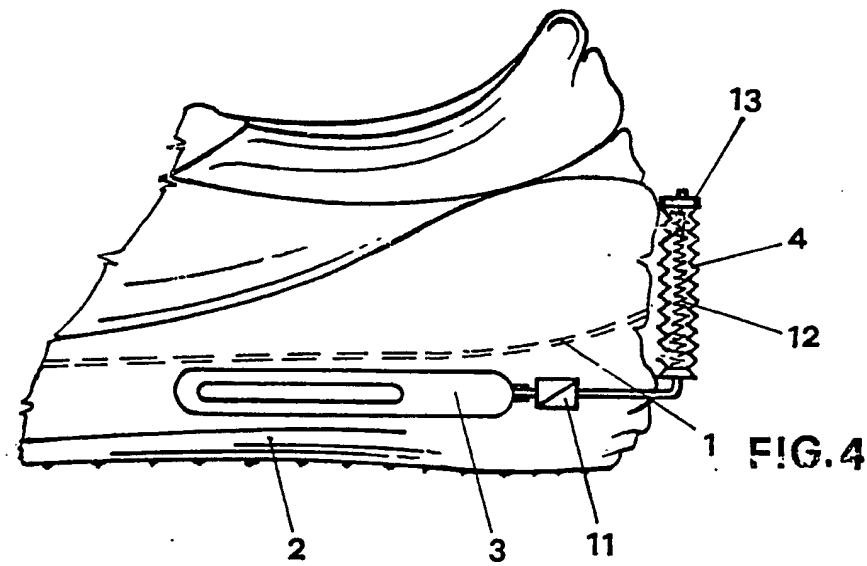


FIG.4

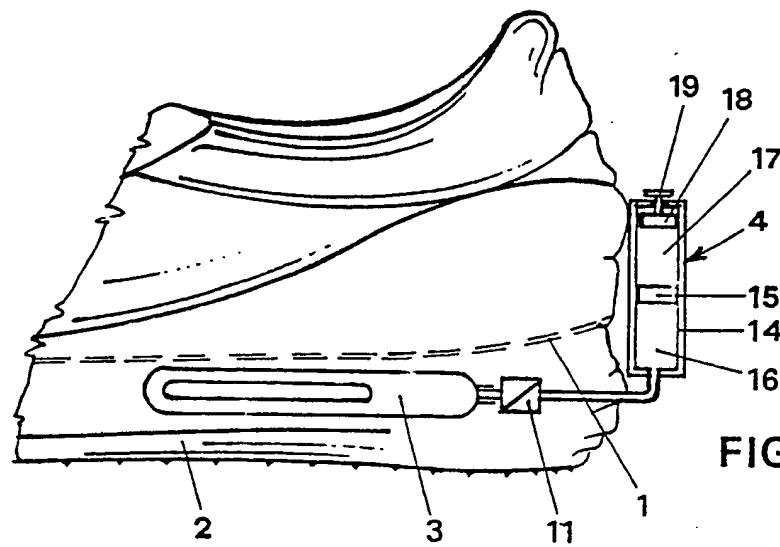


FIG.5

# INTERNATIONAL SEARCH REPORT

International Application No. PCT/EP 89/00299

## I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) \*

According to International Patent Classification (IPC) or to both National Classification and IPC

**IPC<sup>4</sup>**: A 43 B 13/20

## II. FIELDS SEARCHED

### Minimum Documentation Searched <sup>7</sup>

| Classification System | Classification Symbols |
|-----------------------|------------------------|
| IPC <sup>4</sup>      | A 43 B                 |

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>

## III. DOCUMENTS CONSIDERED TO BE RELEVANT \*

| Category * | Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup> | Relevant to Claim No. <sup>13</sup> |
|------------|--|-------------------------------------|
| X          | WO, A, 87/03789 (SAR) 2 July 1987<br>--  | 1,5-8                               |
| A          | FR, A, 2452889 (W. REBER) 31 October 1980<br>--  | 1                                   |
| A          | US, A, 4446634 (P. JOHNSON) 8 May 1984<br>--   | 1                                   |
| A          | US, A, 4237625 (G. COLE) 9 December 1980<br>-----  | 1                                   |

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## IV. CERTIFICATION

Date of the Actual Completion of the International Search

17th May 1989

Date of Mailing of this International Search Report

- 7 JUN 1989

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

P.C.G. VAN DER PUTTEN

**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.**

EP 8900299  
SA 27685

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 31/05/89. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

| Patent document cited in search report | Publication date | Patent family member(s) |          | Publication date |
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| FR-A- 2452889                          | 31-10-80         | DE-A-                   | 3012945  | 23-10-80         |
|  |                  | JP-A-                   | 55133203 | 16-10-80         |
|  |                  | US-A-                   | 4312140  | 26-01-82         |
| US-A- 4446634                          | 08-05-84         | None                    |          |                  |
| US-A- 4237625                          | 09-12-80         | None                    |          |                  |